

MINISTRY OF WATER AND IRRIGATION

Water Resource Policy Support

GROUNDWATER MANAGEMENT COMPONENT

**Curtailment of Groundwater Use for Irrigated Agriculture
in the Amman-Zarqa Basin Uplands:
A Socio-Economic Analysis**

by

**Dr. Amer Jabarin,
University of Jordan**

April, 2001

The Water Resource Policy Support activity is supported by the
United States Agency for International Development (USAID) through a
contract with Associates in Rural Development Inc. (ARD):
USAID/ARD Contract No. LAG-I-00-99-00018-00

Executive Summary

This socio-economic impact assessment examines how the curtailment of irrigation water would change the lives of current and future residents of the Amman-Zarqa basin (AZB) community. The following indicators were selected and used to measure the potential socio-economic impacts:

- Changes in community **demographics**;
- Effects on related economic sectors such as wholesaling and retailing service, input and output markets, processing, transportation;
- Changes in **employment** and **income levels**; and
- Changes in the industrial activities related to Agricultural activities

The introduction of irrigated agriculture in the AZB region in the early sixties has resulted in an increase in the number of housing units, which was accompanied by improvements in the quality of housing in terms of adequacy of space, construction material, and availability of utilities. During the eighties and nineties, the number of both male and female students in public schools increased by almost one-half reflecting the increased awareness of the Badia population of the value of education.

The government's efforts in serving the growing communities in the AZB since the early eighties led to the realization of significant improvement in health services in terms of hospitals, clinics, doctors,...etc.

Irrigated agriculture in the AZB has also resulted in other socio-economic indirect benefits accruing to the whole country that include, among others, enhanced national food supply, enhancement of agribusiness, promotion of government policies related to demographic settlement patterns, social welfare issues and political stability, improving management of natural resources and creating an attractive environment for private sector investment.

The analysis of the socio-economic impacts was based on secondary data collected by the Department of Statistics, Ministry of Agriculture, and mainly on analysis of data collected from the Rapid Appraisal (RA) survey of 156 farms, conducted by the Groundwater Management Component in 2001.

The following five practical options for groundwater use reduction in the AZB were used to formulate four scenarios for reducing the use of groundwater in the AZB basin:

1. Establishing an Irrigation Advisory Services;
2. Wells buy out;
3. Reduction of abstraction by limiting annual abstraction or limiting cropped area;
4. Exchange of groundwater with recycled water; and
5. Municipal and Industrial pumping reduction.

The four scenarios are evaluated in terms of their impacts on: employment levels, income levels of the targeted population groups, wholesaling and retailing activities, agricultural processing, and collateral services supporting agricultural activities in the governorates of Mafraq and Zarqa.

Impacts on labor force: The direct impact of curtailing the use of groundwater for irrigation will be the adverse effects on the growth in new jobs in the AZB communities which may pull workers and their families out of their communities, either those permanent or temporary residents. Currently, the total labor force in the AZB basin is estimated at 7,680 persons. This will be reduced according to the specific scenario adopted. For instance, the lost jobs in case of adopting scenario#1 will reach 3,075 jobs by the year 2010 of which 694 are male foreign labor, 980 are male local labor jobs and 1,402 are female local labor jobs. However, a more severe impact will take place in cases of applying scenarios 2,3 and 4, which correspond to the maximum level of reduction in irrigation water (55 MCM). According to scenarios 2,3 and 4, the total labor loss will reach to 4,305 jobs including 971 male foreign, 1,372 male local, and 1,962 female local.

The results of the analysis showed that the employment rate which is currently at 14 percent, would be increased by another 10 percent. When this occurs, the outgoing population affects the social environment in various ways including lower demand for housing and social services (e.g., health care, education, recreational facilities).

Impacts on incomes: As a matter of fact, the reduction in employment will be accompanied by a direct and indirect loss in income. The total value of direct losses as a result of lost jobs would range from JD 2.74 million according to scenario 1 to JD 4.56 million as in the case of scenario 4. However, since part of the lost jobs belongs to foreign laborers, the net loss to Jordan income will range between JD 1.329 million to JD 2.199 million.

Impacts on the agribusiness sector: The increase in agricultural production in the AZB and the surrounding areas resulted in the establishment of a number of input industries and output processing plants, and other related agribusiness firms mainly in Zarqa and Mafraq. Statistics show that eighty-five agribusiness firms are found in the AZB region which employ a sum of 329 employees with an invested capital of JD 3.8 million and annual sales of JD 3.52 million. These firms include wholesalers of agricultural raw materials, plants for processing and preserving vegetables and fruits, firms for manufacturing vegetable and animal oils and fats, firms for manufacturing agricultural and forestry machinery, and firms for manufacturing electrical motors, generators and transformers.

The potential magnitude of impacts on the agribusiness sector in the AZB varies among the four scenarios. The results indicate that between 43 and 67

employees will lose their jobs and the amount of reduction in sales might vary between JD 457,693 and JD 713,693 if scenarios 1 or 4 are adopted, respectively.

To mitigate the unemployment issue, it is recommended that more emphasis should be placed on encouraging the adoption of improved irrigation systems, intensive production systems and introducing high value crops such as cut flowers, strawberries and late table grapes. Such crops would help in limiting the over abstraction of underground water and would also reduce the unemployment rates in the AZB community.

Another option that could be adopted to mitigate the issue of unemployment is to consider transferring some of the treated wastewater from the As-Samra plant to Hashimihah and Dulayl areas; this would increase the production of forage crops and compensate for the lost jobs due to the adoption of the other reduction options. This option, if it proves economically feasible, would help in reducing the serious shortage in livestock products such as red meats and dairy products due to the lack of forages and feed stuff that Jordan faces.

Another option to deal with the unemployment issue is to consider including the agricultural workers under the social security umbrella. Workers who are covered by this program pay a monthly premium to the social security department for a period of time. At the retirement age, those workers start receiving a monthly salary that would guarantee them a decent life. This approach could be used as a remedy for those who will lose their jobs due to adopting the different scenarios. The cost of this option, which should be compensated by Jordanian society in general, would not exceed JD 14,680,000.

The Badia region was always known as the main area for raising herds of sheep and goats in Jordan. The expansion in irrigated agriculture resulted in a significant reduction in livestock activities in the AZB region and resulted also in the destruction of the fragile rangeland in this area. This option could be used to solve the problem of the local laborers (the Bedwins), who would lose their jobs by providing them with what is called "seed money" to initiate small projects such as buying some sheep and goats. Those laborers who are expected to lose their jobs could be given a compensation that could be used to buy some sheep and goats to start their own business. This approach was adopted by some rural development programs that were implemented through the Ministry of Agriculture in certain parts of Jordan. These programs have proven to be a good vehicle for alleviating poverty in the poor rural areas of Jordan.

TABLE OF CONTENTS

Executive Summary	page 2
1. Introduction	6
2. Population and interest groups	6
3. Improved public health services	11
4. Higher standard of living	11
5. Indirect benefits of irrigated agriculture in Mafraq and Zarqa	11
6. Labor force	12
7. Importance of irrigated agriculture to AZB upland communities	13
8. Assessing the socio-economic impacts of options for curtailing groundwater use in the AZB	15
9. Assessing the impacts on employment and income	16
9.1 Scenario 1	16
9.2 Scenario 2	20
9.3 Scenario 3	20
9.4 Scenario 4	21
9.5 Summary of the socio-economic impacts of Scenarios 2,3 and 4	21
10. Conclusions	25

1. Introduction

The two main governorates located in the Amman-Azraq groundwater basin (AZB) are Mafraq and Zarqa. Irrigated agriculture represents the main economic activity in Mafraq and in many parts of the Zarqa governorate.

The purpose of this report is to determine the main socio-economic impacts of irrigation reduction on the main communities located in the AZB. Socio-economic impact assessment is designed to assist communities in making decisions that promote long-term sustainability, including economic prosperity, a healthy community, and social wellbeing.

A socio-economic impact assessment examines how a proposed change in a development activity will change the lives of current and future residents of a community. The indicators used to measure the potential socio-economic impacts of a development include the following:

- Changes in community **demographics**;
- Effects on related economic sectors such as wholesaling and retailing service, input and output markets, processing, transportation;
- Changes in **employment** and **income levels**; and
- Changes in the industrial activities related to Agricultural activities

Quantitative measurement of such factors is an important component of the socio-economic impact assessment. At the same time, the perceptions of community members about how a proposed change will affect their lives is a critical part of the assessment and should contribute to any decision to move ahead with a decision. In fact, gaining an understanding of community values and concerns is an important first step in conducting a socio-economic impact assessment.

2. Population and interest groups

Population in Jordan will continue to increase with some possible impact of family planning programs, which have been strengthened in recent years and will be more strengthened in the coming years. The population of 1995 is estimated at 4.24 million. The present annual growth rate of population is 3.6, which is one of the highest in the world.

According to the most recent population census conducted in 1994¹, the population of the Mafraq governorate amounted in 1994 to 178,914 of which 93,540 are males and 85,374 are females. The census showed that 169,302 are living inside Jordan of which 9,031 are non-Jordanians. The number of the urban

¹ Department of Statistics, Results of the General Census of Population and Housing of Jordan,"Population Characteristics Volume No.1 and 2, 1997.

and rural population was estimated at 57,798 and 121,116, respectively. Of the rural population, 5,577 are non-Jordanians who mainly work in the services and agricultural activities of the rural communities of the governorate.

The same census showed that the population of the Zarqa governorate amounted in 1994 to 639,469 with 332,2661 males and 306,808 females. It showed also that 634,142 are living in Jordan of which 42,674 are non-Jordanians. The number of the urban and rural population was estimated at 605,304 and 28,774 respectively.

Table 1 shows the distribution of the Jordanian population above the age group of 15 in Mafraq and Zarqa. The table shows that 48 per cent of the population are below the age of 15 and 2% are above the age of 65, indicating that one half of the society is out of working age or are dependents. The table also indicates that 86 percent of the population is below the age of 40 which implies a fairly young society.

Table 1. Distribution of Mafraq and Zarqa Population Living Inside Jordan by Age Groups in 1994

Age Group	Mafraq	Zarqa
Less than 15	81,855	264,725
15 _ 19	20,260	76,970
20 _ 24	16,902	72,253
25 _ 29	12,816	59,333
30 _ 34	8,776	41,222
35 _ 39	6,096	27,492
40 _ 44	5,672	20,102
45 _ 49	4,634	19,482
50 _ 54	4,100	18,204
55 _ 59	3,316	14,715
60 _ 64	2,586	10,473
65 _ 69	1,582	6,364
70 _ 74	1,324	3,865
75 _ 79	574	1,633
80+	781	1,728
Unspec.	126	519
TOTAL	171,400	639,469

Source: General Census of Population and Housing of Jordan, Vol.1, 1997

The area of Mafraq governorate is 25,663 square km equivalent to 27.8% of the whole kingdom's area. This means that the population density is about 7 people per square meter. Mafraq is characterized by the wide dispersion of its population centers which amounted in 1989 to 149 centers scattered over the governorate. Mafraq became a governorate in 1986 and its center is the Mafraq city.

The area of Zarqa governorate is 4,743 square Km representing 5.4% of the kingdom area. The population density is 133 people per square meter, which is much higher than the density in Mafraq.

In the early fifties most of the inhabitants of the AZB highlands were nomadic Bedouin tribes who referred to their region as the "Badia", which is part of the semi-arid and arid parts of rural Jordan which constitutes more than three-fourth of the total area of Jordan.

The major Bedouin tribes in the AZB are the Beni Khaled, Al-Sirhan, Ahl Al-Jabal, and Al-Sardieh in the northeast, which extends north and east of the city of Mafraq to the Iraqi border.² The Beni Shakr tribe lies to the south of the city of Amman and extends into south central Jordan, and east to the Saudi borders. The Al-Masai'd, Al-Isa, Al-Sardieh, Al-Shurafat and Idhamat were located in the north and east. Bani-Hassan was situated from Mafraq to the outskirts of Zarqa and Bani Khaled and Bani Sakher in the Dulayl-Khaldiyya-Hallabat area.

Traditionally, the Bedouins derived their subsistence from herding camels, sheep and goats. The Bedouin way of life is associated with a complex socio-economic system capable of providing a livelihood in a poorly endowed physical habitat.

The Badia habitat is a land starved of water³. The topsoil is thin, fine and largely devoid of moisture. And today, after decades of overgrazing which destroyed much of the vegetation, the plant cover is very poor. The fragile balance in the ecosystem has thus been disturbed. The land is no longer capable of supporting palatable vegetation and is becoming eroded. The herds congregate in areas still covered with plants resulting in further overgrazing.

The army played a crucial role in reshaping the life of the Bedouins. Their doubtless royalty to the kingdom encouraged army recruitment of Bedouin from as early as the inception of the state in 1921. Since military activities were part of the Bedouin tradition, it was easy for them to adapt to the army life, which became their major employer augmenting their meager resources and teaching them new skills. More important, through the army they were slowly integrating into Jordan society.

By the 1950's the nomadic population of the East Bank was estimated at somewhere between 150,000 and 220,000 people or 10% of the Jordanian

² Abu Jaber, K., F. Gharaibeh and A. Hill, "THE BADIA OF JORDAN-The Process of Change" First Edition, Publications of the University of Jordan, Amman, Jordan, 1987.

³ Ibid (Abu Jaber, K., F. Gharaibeh and A. Hill)

population. The first systematic account of the population of the desert areas took place in the 1961 population and housing census.

By the early 1960's sizeable portions of the Bedouin population were already settled or were in the process of settlement. A host of factor appears responsible for settlement. Highway construction was instrumental in both the spontaneous or government-enticed settlement in the south.

Water was one of the most important factors underscoring Bedouin settlement. Life in the Badia depends on the availability of water. Poor rains in the 1970's led to loss of much of their herds and the abandonment of large parts of the traditional areas of pasture and the establishment of settlement. Many of the villagers in the northeast Badia area were then established around the relics of ancient Roman wells and reservoirs⁴.

The process of the settlement of the Badia followed a fairly regular pattern. The final phase was the initial cultivation of the land and tying the Bedouin more to the land especially at planting and harvest seasons. The Bedouin way of making a living has changed completely. The herds of camels and sheep used to be regarded as the only form of wealth. As Bedouin have had to shift from animal husbandry to agriculture income, they have experienced great difficulties. Most of the cultivation is in the best range areas and is dry-farmed, the main crops being wheat and barley. Yields were low and Badia cultivation had probably, on the average, failed to yield positive returns.

Agricultural income constituted but a very negligible portion of household income. The Bedouin was venturing into an area in which he had virtually no knowledge or experience, i.e. agriculture, with the concomitant result of the erosion of an already meager soil. Serious consideration should be given to the return of those lands to grazing, since the population possesses the basic knowledge and techniques for the successful utilization of this resource. The reincorporating of this area into pasture areas would be in the best interests of the indigenous people as well as the country as a whole⁵.

During the eighties, the government launched an intensive program of investment in roads, schools, clinics and other public services in the Badia region, which improved living conditions significantly. Table 2 shows that the hair tents, which characterize the life of Bedouin, represents only 3 percent of the total types of buildings in the rural areas of Mafraq. Dar, which is a conventional building of one room or more and may be surrounded by a fence and could be of two floors served by uncovered stairs, represent about 80% of the total buildings found in the rural areas of Mafraq. This indicates that the

⁴ Ibid (Abu Jaber, K., F. Gharaibeh and A. Hill)

⁵ Ibid (Abu Jaber, K., F. Gharaibeh and A. Hill)

majority of Bedouins have moved to permanent dwellings and abandoned the nomadic lifestyle.

Table 2. Distributions of Buildings by Type of Building in the Rural Areas of Mafraq and Zarqa Governorates in 1994

Building Type	Mafraq		Zarqa	
	No. of buildings	%	No. of buildings	%
Amarah	847	4%	331	5%
Dar	18,245	79%	4,871	71%
Villa	60	0%	14	0%
Barracks	153	1%	266	4%
Hair Tent / Tent	725	3%	459	7%
Establishment	2,301	10%	744	11%
Under Construction	520	2%	129	2%
Other	83	0%	20	0%
Unspecified	30	0%	9	0%
Total	22,964	100%	6,843	100%

Source: General Census of Population and Housing of Jordan 1994

The increase in the number of housing units was accompanied by improvements in the quality of housing in terms of adequacy of space, construction material, and availability of utilities, so that houses are becoming more comfortable for living.

During the eighties and nineties, the number of both male and female students increased by almost one-half reflecting the increased awareness of the Badia population to the value of education as shown in Table 3.

Table 3. Students Enrolled in All Stages Of School Education in Zarqa and Mafraq Governorates During 1991-1998

	Zarqa				Mafraq			
	1986/87	1991/92	1995/96	1997/98	1986/87	1991/92	1995/96	1997/98
Male	53,887	95,290	101,347	103,022	17,997	23,948	28,416	30,889
Female	52,318	90,390	97,498	102,202	15,036	21,584	25,761	28,365
Total	106,205	185,680	198,845	205,224	33,033	45,532	54,177	59,254

Sources: Department of Statistics, Education Statistics, 1997- 1999

The development efforts during the nineties included the construction of 35 and 59 new schools in Mafraq and Zarqa, respectively, which were fully furnished and equipped with the necessary laboratories and libraries.

In fact education allowed for changing the Mafraq and the rural areas of Zarqa into an open class society with a higher rate of social mobility. It provided opportunities leading to a greater degree of social integration with the rest of the country.

3. Improved public health services

The developments effort in the Mafraq and Zarqa since early eighties led to the realization of significant improvement in health services.

There were very few clinics in the Mafraq and Zarqa area before the year 1970. These were small and incapable of providing adequate medical services to the community. Health services have been expanding rapidly in the area. In the year 1998, the number of built primary clinics amounted to 86 and 79 in Zarqa and Mafraq, respectively. The locations of these clinics were determined in accordance with the needs of the settlement in the two governorates.

Currently there are 165 governmental health care centers in both governorates of which 50 are primary care clinics, 42 village clinics, 42 mother and child care centers, 2 chest disease centers and 29 dental clinics.

4. Higher standard of living

Improvement in the quality of life is mainly a function of an improvement in income, housing, social services, and public utilities available for the population.

- The construction of the infrastructure for irrigated agriculture by mainly the private sector led to the expansion of the cultivated area and to a significant increase in production intensity and efficiency. The result was the creation of better production opportunities, more jobs and higher incomes, which meant increased capability of the people in the two governorates to satisfy their needs and enjoy a better quality of life.
- The construction of the physical infrastructure for public utilities including roads, electricity, and drinking water, and the provision of social services including education and health services, turned the rural areas in the two governorates into a suitable place to work and live in with sufficient pull factors to maintain the local people and attract investors and workers.

5. Indirect benefits of irrigated agriculture in Mafraq and Zarqa

The indirect benefits of irrigated agriculture in the two governorates are those socio-economic benefits accruing to the whole country. These include, among

others, enhanced national food supply, enhancement of agribusiness, promotion of government policies related to demographic settlement patterns, social welfare issues and political stability, improving management of natural resources and creating an attractive environment for private sector investment.

6. Labor Force

The combined impact of agricultural and infrastructure development in Mafrqa and Zarqa was also reflected in the large increase in the total work force engaged in agricultural and agribusiness activities. Around 79% of the work force in 1994 were engaged in field production activities, 15% in government institutions and technical support activities and 6% in private sector input supply marketing and processing activities (excluding retailing).

In 1999 the total number of the economically active population was estimated at 1.449 million of which 1.115 million males and 0.333 million females⁶. Out of this total labor force, around 68,851 workers or 4.8% are engaged in agriculture, of which 24,522 are permanent labor and the rest are either seasonal or casual. According to the Department of Statistics, a seasonal worker is that person who works in a holding for a duration of one-third to two-thirds of the agricultural year (4-8) months whereas casual worker is that person who works in a holding for a duration of less than one-third of the agricultural year (less than 4 months).

It is clear from table 4 that in 1999 the agriculture sector employed a large number of foreign workers, estimated at 44,905 (65% of total permanent and seasonal hired agricultural labor). An unofficial estimate on foreign labor is not available. However, in 1995 a report on agricultural marketing in Jordan estimated their number at about 80,000. During the last three years, the Ministry of Labor tightened the hiring procedures of foreign labor including those hired by the agriculture sector and simultaneously intensified its campaigns on illegal workers in all areas in an effort to reduce the Jordanian unemployment rate.

Schiffler⁷ stated that there are several indirect benefits which will be forgone in the case of reducing irrigation water use that include:

1. Reduction of rural-urban migration
2. Business opportunities for industries that depend on agriculture as a supplier of raw materials and as a market

⁶ Ministry of Planning, Department of Statistics, Annual Agricultural Statistics, 1999

⁷ Schiffler, Manuel, The Economics of Groundwater Management in Arid Countries: Theory, International Experience and a Case Study of Jordan, London and Portland, Oregon: Frank Cass Press, Published in association with the German Development Institute, 1998.

3. Limiting desertification representing a gain of value in both ecological and aesthetic terms; and
4. Preservation of rural livelihoods through irrigation.

Table 4 demonstrates that female workers represent 21% of the total agricultural labor in Jordan of which are 99% are seasonal or casual labor. The lower part of the table shows the labor situation in the highlands. Agricultural activities in the highlands employ 72% of the total agricultural labor in the country. Male laborers counts for about 78% and the rest are females. Non-Jordanians forms about 65% of the total labor engaged in Agricultural in the highlands. The table also shows that 98% of the total employed females are found in the highlands.

The RA survey conducted by MWI/ARD⁸ showed that in the AZ highland there are 4479 laborers with 1192 in Zarqa and 3297 inn Mafraq. About 26.6% of total laborers in Zarqa area are permanent and 73.4% seasonal, while in Mafraq 18% are permanent and 82% seasonal. The survey has also showed that around 53.7% of Zarqa and 74.1% of Mafraq agricultural total labor force are females.

Table 4. Distribution of Agricultural Labor in Jordan in 1999

Distribution of Hired Labor by Type of Labor, Gender, and Nationality in Jordan in 1999							
	Permanent Labor		Seasonal Labor		Casual Labor		Total
Gender	Jordanians	Non-Jordanians	Jordanians	Non-Jordanians	Jordanians	Non-Jordanians	
Male	3,356	21,004	680	4,486	9,399	15,472	54,397
Female	63	99	822	149	9,626	3,695	14,454
Total	3,419	21,103	1,502	4,635	19,025	19,167	68,851
Distribution of Hired Labor by Type of Labor, Sex, and Nationality in the Highlands in 1999							
	Permanent Labor		Seasonal Labor		Casual Labor		Total
Gender	Jordanians	Non-Jordanians	Jordanians	Non-Jordanians	Jordanians	Non-Jordanians	
Male	2,537	14,269	531	2,307	6,784	12,036	38,464
Female	-	24	449	-	6,998	3,620	11,091
Total	2,537	14,293	980	2,307	13,782	15,656	49,555

Source: Dept. of Statistics, Annual Agricultural Statistics, 1999

7. Importance of Irrigated Agriculture to AZB upland communities

The total cultivated area in Jordan was estimated at 3.055 million dunums in 1999, of which 26% is irrigated and about 74% is rainfed (table 5). Around 285 thousand dunums in the Jordan Valley are mainly under irrigation in the northern ghor, the middle ghor, southern ghor, and in Karak Safi ghor). And the rest 2.74 million dunums are in the highlands and in the Badia area, of which 478 thousand are irrigated mainly from groundwater (table 5).

⁸ MWI/ARD, Water Resource Policy Support Project, Groundwater Management Component, "Study of Water Use and Users in the Northeast Amman-Zarqa Basin" January 2001.

In 1999, around 62% of the cropped irrigated area in the highlands was allocated to horticultural production (50% for fruit trees and 39% for vegetables), while only 11% was used for field crops, mainly in the Disi area.

Table 5. Irrigated and Non-Irrigated Areas in Jordan as whole and in the highlands in 1999

JORDAN			
Crop	Total Area	Irrigated Area	Non-Irrigated Area
Fruit trees	857,276	339,691	517,585
Vegetables	357,414	338,121	19,292
Field Crops	1,839,854	109,737	1,730,117
Total	3,054,544	787,549	2,266,994
Highlands			
Crop	Total Area	Irrigated Area	Non-Irrigated Area
Fruit trees	751,377	235,339	516,037
Vegetables	205,619	187,196	18,424
Field Crops	1,783,186	53,780	1,729,406
Total	2,740,182	476,315	2,263,867

Source: Dept. of Statistics, Annual Agricultural Statistics, 1999

Statistics on the number and size of agricultural holdings in the highlands or the Badia areas are not available, however it is believed that in general agricultural holdings in these areas are small except for those found in Mafraq, Azraq, eastern part of Amman, Shoubak and Disi.

The rapid appraisal (RA) survey, conducted by MWI/ARD in April-June 2000, showed that the average farm size in the AZB is 318 dunums, which is a relatively large size compared to the Jordan Valley and other parts of the country. The survey indicated that olive trees are the dominant crop in the AZB occupying 35.5% and 54.5% of the total cropped area in Mafraq and Zarqa, respectively. Tomatoes were the second predominant crop in Mafraq (18.1%) followed by melon (9.1%), apple (8.4%), peaches (7.2%) and cauliflower/cabbage (5.7%). However, the second predominant crop in Zarqa was apple (7.3%) followed by peaches (4.8%), tomatoes (4.6%), Alfalfa (4.5%), barley (1.4%) and cauliflower (3.2%). Field crops and fodder grass represented, respectively only 2.6% and 0.1% of the cultivated area in Mafraq versus 5% and 4.5% in Zarqa.

A recent study⁹ on marketing constraints facing horticultural products in Jordan stated that a preliminary analysis of available data showed that there are about 1,400 irrigated farms used for the production of fruits and vegetables with an area of 200 dunums or more of which 120 are in the Jordan Valley and the rest in the highlands and the Badia region.

⁹ Export Promotion Project “Constraints on Marketing Fresh Produce in Jordan”. A Project funded by the GTZ- Deutsche Gesellschaft für Technische Zusammenarbeit GTZ (GmbH) Amman, Jordan. 1977.

8. Assessing the socio-economic impacts of options for curtailing groundwater use in the AZB

The five practical options for groundwater use reduction in the AZB that were presented in the study of water use and users in the Northeastern AZB included¹⁰:

- Establishing an Irrigation Advisory Services;
- Wells buy out;
- Reduction of abstraction by limiting annual abstraction or limiting cropped area;
- Exchange of groundwater with recycled water; and
- Municipal and Industrial pumping reduction.

These options were used to formulate several scenarios for reducing the use of groundwater in the AZB basin. In the following part of the report four scenarios are evaluated in terms of its impacts on: employment levels, income levels of the targeted population groups, wholesaling and retailing activities, agricultural processing, and collateral services supporting agricultural activities in the governorates of Mafraq and Zarqa.

DATA SOURCES

Several data sources were utilized to conduct the socio-economic analysis including:

- The Rapid Appraisal of Groundwater Use and Users in Amman-Zarqa Basin Highlands¹¹. The primary data collected by the survey and the results of the study were used as the basis for the socio-economic analysis
- The "1994 Department of Statistics Population and Housing Census" The Census was used to establish the baselines for the community as well as provide an indication of estimated changes in population.
- The annual report by the Ministry of Agriculture, The Agricultural Marketing Organization and the Department of Statistics.
- Interviews with selected farmers in the basin.

¹⁰ MWI/ARD, Water Resource Policy Support Project, Groundwater Management Component, "Study of Water Use and Users in the Northeast Amman-Zarqa Basin" January 2001.

¹¹ Ministry of Water and Irrigation, Water Resource Policy Support Project, Groundwater Management Component, "Rapid Appraisal of Groundwater Use and Users in Amman-Zarqa Basin Highlands," draft, January 2001

9. Assessing the impacts on employment and income

Development directly influences changes in employment and income opportunities in communities. Such changes may be more or less temporary (e.g., seasonal employment) or may constitute a permanent change in the employment and income profile of the community. Assessing these types of changes is an important component of social impact analysis because decline in employment lowers demands on community services and resources. In the following section we assess the four management scenarios grouping more than one option, which were developed, based on priority-cost-difficulty of implementation for each option. A detailed presentation will be given to scenario 1 only to demonstrate the methodology of the analysis. The results of the other three scenarios will be summarized and presented in specific tables.

9.1 Scenario #1:

This scenario (Table 6) is a combination of conducting three water management options, which should result in a total reduction of irrigation water by 30 million cubic meters by the year 2020. The options are:

- Irrigation advisory service (5 MCM);
- Minimums buy-out of wells (15 MCM); and
- Minimum Abstraction limit (10 MCM).

Table 6 Main Components of Groundwater Use Reduction Scenario 1										
Scenario 1	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010-2020
IAS	0	0	1	2	3	4	5	5	5	5
Buy-out	0	0	3	6	9	12	15	15	15	15
Abst/Crop	0	0	2	3	4	5	6	6	6	10
Total Reduction: Irrigation (Mcbm)	0	0	6	11	16	21	26	26	26	30

EXPECTED IMPACTS OF SCENARIO 1:

Impacts on cultivated area:

As understood from table 7, the gradual reduction of water use will result in a gradual reduction in the cultivated area with seasonal crops and fruit trees. The reduction in area is due to the buy out of wells and reducing abstraction limit. The table indicates that the cultivated area in the basin region in both Mafrqa and Zarqa will be reduced to 76,233 by the year 2007 and reaches to 70,753 dunum in 2010. The total area was split into seasonal crop and fruit trees based on the cropping pattern, which was identified during the RA. The planned reduction in acreage was estimated by dividing the total amount of

annual planned abstraction, after reducing waters by the average water requirement per one dunum of land (730 CM).

Table 7. Impact of Water Reduction of Scenario 1 on Annual Cultivated Area in AZB (2001-2020)										
	Cropped Area (dunum)									
Governorate	٢٠٠١	2002	2003	2004	2005	2006	2007	2008	2009	2010-2020
Mafraq										
Seasonal Crop	28,665	28,665	25,139	22,318	19,497	16,677	13,856	13,856	13,856	11,035
Fruit Trees	39,585	39,585	38,234	37,154	36,073	34,993	33,912	33,912	33,912	32,832
Zarqa										
Seasonal Crop	8,085	8,085	7,090	6,295	5,499	4,704	3,908	3,908	3,908	3,112
Fruit Trees	28,665	28,665	27,687	26,904	26,122	25,340	24,557	24,557	24,557	23,775
Total area of SC	36,750	36,750	32,229	28,613	24,997	21,380	17,764	17,764	17,764	14,147
Total area of FT	68,250	68,250	65,921	64,058	62,195	60,332	58,469	58,469	58,469	56,606
Grand Total	105,000	105,000	98,151	92,671	87,192	81,712	76,233	76,233	76,233	70,753

Impacts on direct labor losses:

Labor requirement per one dunum varies according to the type of cultivated crop and the region. The Rapid Survey provided detailed labor requirements for both seasonal crops and fruit trees cultivated in the basin. The collected data by the Survey was used to derive the labor requirement per one dunum of land as shown in table 8. The table includes detailed data classified by gender (male foreign labor, male local labor, and female labor) and by labor type (permanent and temporary). These estimates were verified through comparison with crop budgets that had been developed in studies of Jordan Valley farms and other areas.

Table 8. Labor requirements in person month per dunum of land in Mafraq and Zarqa					
Type of Labor	Male Foreign Labor		Male Local Labor		Female labor
	Perm.	Temp.	Perm.	Temp.	Temp. Only (local)
Mafraq					
Seasonal Crop	0.17	0.03	0.07	0.16	0.36
Fruit Trees	0.15	0.04	0.05	0.09	0.10
Zarqa					
Seasonal Crop	0.19	0.05	0.10	0.21	0.20
Fruit Trees	0.18	0.06	0.04	0.06	0.09

The total labor requirement for the expected cultivated area during the period (2001-2020) was then calculated by multiplying the annual acreage of seasonal crops and fruit trees in both governorates by the different types of labor included in table 8. The estimated total labor requirement for the period (2001-

2020) is portrayed in table 9. The total labor force needed in the AZB basin in 2001 was estimated at 7,680 persons, which will be reduced to 5,097 persons in the year 2007 and to 4,605 persons by the year 2010 onwards.

Table 9. Total Labor Requirement for Agricultural Activities in AZB during (2001-2020)										
Scenario 1	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010-2020
Mafrq										
Male Perm. Foreign Labor	881	881	816	763	711	659	607	607	607	555
Male Temp. Foreign Labor	385	385	360	339	319	299	278	278	278	258
Male Perm. Local Labor	340	340	314	293	272	252	231	231	231	210
Male Temp. Local Labor	1,358	1,358	1,244	1,152	1,061	970	878	878	878	787
Female Labor	2,387	2,387	2,154	1,968	1,782	1,596	1,410	1,410	1,410	1,224
Zaraq										
Male Perm. Foreign Labor	558	558	528	503	479	455	430	430	430	406
Male Temp. Foreign Labor	343	343	325	311	297	283	269	269	269	254
Male Perm. Local Labor	160	160	148	140	131	122	113	113	113	104
Male Temp. Local Labor	570	570	525	489	454	418	382	382	382	347
Female Labor	699	699	652	613	575	537	499	499	499	460
Sub-Total										
Male Perm. Foreign Labor	1,439	1,439	1,343	1,267	1,190	1,114	1,037	1,037	1,037	960
Male Temp. Foreign Labor	728	728	685	650	616	581	547	547	547	513
Male Perm. Local Labor	499	499	462	433	403	373	344	344	344	314
Male Temp. Local Labor	1,928	1,928	1,769	1,642	1,515	1,388	1,261	1,261	1,261	1,133
Female Labor	3,086	3,086	2,806	2,581	2,357	2,133	1,909	1,909	1,909	1,684
Grand-Total	7,680	7,680	7,065	6,573	6,081	5,589	5,097	5,097	5,097	4,605

The direct annual labor losses in a given year were estimated by deducting the amount of needed labor from the previous year. Table 10 shows that no labor losses during 2001-2002, however the losses start in the subsequent years. By 2010 the total labor losses will reach to 3,075 jobs of which 694 are male foreign labor, 980 are male local labor jobs and 1,402 are female local labor jobs.

Impacts on direct and indirect income losses by laborers:

Lost jobs as a result of acreage reduction will directly cost a sum of JD 2.692 million of which JD 1.431 will be incurred by Jordanian laborers and the rest JD 1.26 million will be incurred by foreign labor as shown in table 11. The calculations were based on the assumption that the monthly salary paid to a laborer is equivalent to JD 120. The total number of lost jobs in table 5.10 was multiplied by JD 120 to derive table 11. The foreign labor lost jobs will correspond to a saving of foreign hard currency equivalent to US\$ 1.801 million.

Table 10. Direct Annual Loss in Jobs as a Result of Applying Scenario # 1 in AZB During (2001-2020)											
Scenario 1	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011-2020
Mafrq											
Male Perm. Foreign Labor	0	0	65	52	52	52	52	0	0	52	0
Male Temp. Foreign Labor	0	0	25	20	20	20	20	0	0	20	0
Male Perm. Local Labor	0	0	26	21	21	21	21	0	0	21	0
Male Temp. Local Labor	0	0	114	91	91	91	91	0	0	91	0
Female Labor	0	0	233	186	186	186	186	0	0	186	0
Zaraq											
Male Perm. Foreign Labor	0	0	30	24	24	24	24	0	0	24	0
Male Temp. Foreign Labor	0	0	18	14	14	14	14	0	0	14	0
Male Perm. Local Labor	0	0	11	9	9	9	9	0	0	9	0
Male Temp. Local Labor	0	0	45	36	36	36	36	0	0	36	0
Female Labor	0	0	48	38	38	38	38	0	0	38	0
Total											
Male Perm. Foreign Labor	0	0	96	77	77	77	77	0	0	77	0
Male Temp. Foreign Labor	0	0	43	34	34	34	34	0	0	34	0
Male Perm. Local Labor	0	0	37	30	30	30	30	0	0	30	0
Male Temp. Local Labor	0	0	159	127	127	127	127	0	0	127	0
Female Labor	0	0	280	224	224	224	224	0	0	224	0

Table 11. Annual Lost Income by Laborers as a Result of Applying Scenario # 1 in AZB During (2001-2020) (Thousand JD)											
Scenario 4	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011-2020
Mafrq											
Male Perm. Foreign Labor	0	94	75	75	75	75	94	0	0	75	0
Male Temp. Foreign Labor	0	18	15	15	15	15	18	0	0	15	0
Male Perm. Local Labor	0	37	30	30	30	30	37	0	0	30	0
Male Temp. Local Labor	0	82	66	66	66	66	82	0	0	66	0
Female Labor	0	167	134	134	134	134	167	0	0	134	0
Zaraq											
Male Perm. Foreign Labor	0	44	35	35	35	35	44	0	0	35	0
Male Temp. Foreign Labor	0	13	10	10	10	10	13	0	0	10	0
Male Perm. Local Labor	0	16	13	13	13	13	16	0	0	13	0
Male Temp. Local Labor	0	32	26	26	26	26	32	0	0	26	0
Female Labor	0	34	28	28	28	28	34	0	0	28	0
Total											
Male Perm. Foreign Labor	0	138	110	110	110	110	138	0	0	110	0
Male Temp. Foreign Labor	0	31	25	25	25	25	31	0	0	25	0
Male Perm. Local Labor	0	53	43	43	43	43	53	0	0	43	0
Male Temp. Local Labor	0	114	92	92	92	92	114	0	0	92	0
Female Labor	0	202	161	161	161	161	202	0	0	161	0
Total lost income (000') JD	0	0	538	431	431	431	431	0	0	431	0
Net loss to Jordanian income (000') JD	0	0	286	229	229	229	229	0	0	229	0

Since the losses in jobs will take place due to government action, the forced laborers who will leave their jobs should be compensated. In this case, a social cost should be added to the direct losses incurred by those who will lose their jobs especially permanent jobs. One way to estimate the amount of compensation is to consider what private companies pay their employees in case they force them to quit their jobs. These companies usually pay lump sum compensation equivalent to a sum of three month in advance. In other words, the proposed compensation will amount to about one-fourth of the annual income of the laborer. Based on this assumption the total direct and indirect costs will reach to JD 3.365 million.

9.2 Scenario 2

As in scenario 1, this scenario is also a combination of three water management options that should result in a total reduction of irrigation water equivalent to 40 million cubic meters by the year 2020 (table 12). The options are:

- Irrigation advisory service (5 MCM);
- Maximum buyout of wells (20 MCM); and
- Maximum Abstraction limit (15 MCM). The different impacts of this scenario are presented in the summary tables 15 through 19.

Table 12. Main Components of Groundwater Use Reduction Scenario 2										
Scenario 2	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010-2020
IAS	0	0	1	2	3	4	5	5	5	5
Buy-out	0	0	4	8	12	16	20	20	20	20
Abst/Crop	0	0	2	4	6	8	10	10	10	15
Total Reduction: Irrigation (MCM)	0	0	7	14	21	28	35	35	35	40

9.3 Scenario 3

Table 13 contains the detailed description of scenarios 3. In this scenario the concept of treated recycled water is introduced as a management option. This scenario groups four management options including the three options of scenario 2 and the reuse option for Hashimiya-Dulayl-Hallabat, which starts in 2005 with 10 MCM, followed by an additional 5 MCM in 2010. Part of the total reduction of 55 MCM comes from irrigation use (40 MCM) the rest from reuse (15 MCM). The different impacts of this scenario are presented in the summary tables 15 through 19.

Table 13. Main Components of Groundwater Use Reduction Scenario 3										
Scenario 3	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010-2020
IAS	0	0	1	2	3	4	5	5	5	5
Buy-out	0	0	4	8	12	16	20	20	20	20
Abst/Crop	0	0	2	4	6	8	10	10	10	15
Reuse	0	0	0	0	10	10	10	10	10	15
Reduction due to Reuse	0	0	0	0	10	10	10	10	10	15
Total Reduction: Irrigation (MCM)	0	0	7	14	21	28	35	35	35	55

9.4 Scenario 4

Five management options are included in this scenario. The options include those of scenario 3 in addition to the Municipal and Industrial option. This scenario corresponds to a total groundwater use reduction of 85 MCM, which balances the planned abstraction in 2020 with the safe yield (70 MCM) of groundwater in the AZB highlands (Table 14). The different impacts of this scenario are presented in the summary tables 15 through 19.

Table 14. Main Components of Groundwater Use Reduction Scenario 4										
Scenario 4	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010-2020
IAS	0	0	1	2	3	4	5	5	5	5
Buy-out	0	0	4	8	12	16	20	20	20	20
Abst/Crop	0	0	2	4	6	8	10	10	10	15
Reduction due to Reuse	0	0	0	0	10	10	10	10	10	15
Reuse	0	0	0	0	10	10	10	10	10	10
Total Reduction: Irrigation (MCM)	0	0	7	14	21	28	35	35	35	55
M&I (rehab)	0	0	0	0	2	4	6	8	10	10
M&I (Disi-others)	0	0	0	0	3	6	9	12	16	20

9.5 Summary of the Socio-economic impacts of Scenarios 2,3 and 4

Impacts on direct job losses and unemployment:

Table 5.15 shows the impact of the four management scenarios on lost jobs of both local and foreign labor. As expected, the curtailment of irrigation water through the different options would have a negative impact on agricultural employment in the AZB. The table indicates that as the amount of water reduction increases, the number of lost jobs also increases. The severe impact will take place in case of applying scenarios 2,3 and 4, which corresponds, to the maximum level of reduction (55 MCM). According to these scenarios, the total labor loss will reach to 4,305 jobs including 971 male foreign, 1,372 male local, and 1,962 female local.

Table 15. Annual Lost Jobs as a Result of Applying The Different Scenarios in AZB During (2001-2020)											
Scenario #	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011-2020
Scenario 1											
Male Foreign Labor	0	0	139	111	111	111	111	0	0	111	0
Male Local Labor	0	0	196	157	157	157	157	0	0	157	0
Female Labor	0	0	280	224	224	224	224	0	0	224	0
Scenario 2											
Male Foreign Labor	0	0	166	166	166	166	166	0	0	139	0
Male Local Labor	0	0	235	235	235	235	235	0	0	196	0
Female Labor	0	0	336	336	336	336	336	0	0	280	0
Scenario 3											
Male Foreign Labor	0	0	166	166	166	166	166	0	0	139	0
Male Local Labor	0	0	235	235	235	235	235	0	0	196	0
Female Labor	0	0	336	336	336	336	336	0	0	280	0
Scenario 4											
Male Foreign Labor	0	0	166	166	166	166	166	0	0	139	0
Male Local Labor	0	0	235	235	235	235	235	0	0	196	0
Female Labor	0	0	336	336	336	336	336	0	0	280	0

The most recent statistics on employment shows that the unemployment rates in the AZB region is about 14.1 percent between males and 20.6 percent between females. According to the DOS population estimates, the total population of the AZB has reached to 97,832 in 1999. Using population projections by the DOS for the years 2001-2020, the impact of the four scenarios on unemployment in the AZB region was determined as shown in table 16 below.

The table shows that according to scenario 1, the annual unemployment rate among males will rise during the period 2003-2007 by an average of 4.6 percent and among females by an average of 4.9 percent. However, the highest increase in unemployment between both males and females will take place when the other three scenarios are adopted. The annual rate will reach to 9.3 and 9.9 percent among males and females, respectively.

Impacts on direct and indirect income losses by laborers:

The reduction in employment shown in table 15 will be accompanied by a direct and indirect loss in income. Table 17 demonstrates the value of direct losses as a result of lost jobs. It shows that the total direct loss ranges from JD 2.74 million according to scenario 1 to JD 4.56 million as in the case of scenario 4. However, since part of the lost jobs belongs to foreign laborers, the net loss to Jordan income will range between JD 1.329 to JD 2.199.

Table 16. Expected Impacts of the Major Scenarios on Unemployment Rate in AZB during 2001-2020												
Scenario #	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011-2020	
Scenario 1												
Male Local Labor	0	0	5.8%	4.5%	4.4%	4.3%	4.1%	0.0%	0.0%	3.8%		0.0%
Female Labor	0	0	6.1%	4.7%	4.6%	4.5%	4.4%	0.0%	0.0%	5.4%		0.0%
Scenario 2												
Male Local Labor	0	0	9.8%	9.5%	9.3%	9.0%	8.8%	0.0%	0.0%	6.8%		0.0%
Female Labor	0	0	10.5%	10.2%	9.9%	9.6%	9.4%	0.0%	0.0%	7.2%		0.0%
Scenario 3												
Male Local Labor	0	0	9.8%	9.5%	9.3%	9.0%	8.8%	0.0%	0.0%	6.8%		0.0%
Female Labor	0	0	10.5%	10.2%	9.9%	9.6%	9.4%	0.0%	0.0%	7.2%		0.0%
Scenario 4 (as in #3)												
Male Local Labor	0	0	9.8%	9.5%	9.3%	9.0%	8.8%	0.0%	0.0%	6.8%		0.0%
Female Labor	0	0	10.5%	10.2%	9.9%	9.6%	9.4%	0.0%	0.0%	7.2%		0.0%

Table 17. Annual Lost Income by Laborers in AZB During (2001-2020) (In Thousand JD)											
Scenario #	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010-2020	
Scenario 1											
Total Lost Income	0	0	538	431	431	431	431	0	0	431	
Net Loss to Jordan Income	0	0	286	229	229	229	229	0	0	229	
Scenario 2											
Total Lost Income	0	0	646	646	646	646	646	0	0	538	
Net Loss to Jordan Income	0	0	343	343	343	343	343	0	0	286	
Scenario 3											
Total Lost Income	0	0	646	646	646	646	646	0	0	538	
Net Loss to Jordan Income	0	0	343	343	343	343	343	0	0	286	
Scenario 4 (as in #3)											
Total Lost Income	0	0	646	646	646	646	646	0	0	538	
Net Loss to Jordan Income	0	0	343	343	343	343	343	0	0	286	

Impacts on the agribusiness sector in Mafraq and Zarqa:

The collective impact of agricultural and infrastructural development in the AZB and in the surrounding areas in Mafraq and Zarqa was also reflected in the increase in the in agribusiness activities. To assist the increasing agricultural production in the AZB and the surrounding areas many of input industries and output processing plants and other related agribusiness firms were established mainly in Zarqa and Mafraq. As shown in table 18 these included: 37 wholesalers of agricultural raw materials, 6 plants for processing and preserving vegetables and fruits, 19 firms for manufacturing vegetable and animal oils and fats, 9 firms for manufacturing agricultural and forestry machinery, and 14 firms for

manufacturing electrical motors, generators and transformers. The total number of firms is 85 employing a sum of 329 employees with an invested capital of JD 3.8 million and annual sales of JD 3.52 million.

It is apparent that the reduction of cultivated area in the AZB will result in a decline in the agribusiness activities in Mafrq and Zarqa governorate. The magnitude of impacts varies among the different four scenarios. The expected impacts of the four scenarios are presented in table 19.

In reality, those are the indirect impacts of adopting the scenarios. The results indicate that between 43 and 67 employees will lose their jobs and the amount of reduction in sales might vary between JD 457,693 and JD 713,693 if scenarios 1 or 4 are adopted.

Table 18. Agribusiness Activities in Zarqa and Mafrq				
Governorate	Number	# of Employees	Capital	Sales
Wholesale Of Agricultural Raw Materials And Live Animals				
Zarqa	20	51	393600	816059
Mafrq	17	25	38600	293760
Processing And Preserving Of Fruit And Vegetables				
Zarqa	2	11	31200	25600
Mafrq	4	50	1000000	56009
Manufacture Of Vegetable And Animal Oils And Fats				
Zarqa	3	3	640000	90000
Mafrq	16	129	1234450	1817225
Manufacture Of Agricultural And Forestry Machinery				
Zarqa	7	24	56800	174077
Mafrq	2	2	7500	3500
Manufacture Of Electric Motors, Generators And Transformers				
Zarqa	1	10	30000	93384
Mafrq	13	24	375000	154844
TOTALS				
Governorate	Number	# of Employees	Capital	Sales
Zarqa	33	99	1,151,600	1,199,120
Mafrq	52	230	2,655,550	2,325,338
TOTALS	85	329	3807150	3524458

Table 19. Expected Impacts of the Major Scenarios on the Collateral Services in Mafraq & Zarqa during 2001-2020											
Scenario #	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2010-2020
Scenario 1											
# of lost jobs	0	0	10	8	8	8	8	0	0	8	0
Lost Sales in JD	0	0	108,974	87,180	87,180	87,180	87,180	0	0	87,180	0
Scenario 2											
# of lost jobs	0	0	12	12	12	12	12	0	0	10	0
Lost Sales in JD	0	0	130,769	130,769	130,769	130,769	130,769	0	0	108,974	0
Scenario 3											
# of lost jobs	0	0	12	12	18	12	12	0	0	10	0
Lost Sales in JD	0	0	130,769	130,769	189,615	130,769	130,769	0	0	108,974	0
Scenario 4 (as in #3)											
# of lost jobs	0	0	12	12	18	12	12	0	0	10	0
Lost Sales in JD	0	0	130,769	130,769	189,615	130,769	130,769	0	0	108,974	0

10. Conclusions

The socio-economic impacts of adopting the four scenarios could be classified into direct and indirect impacts. A direct impact of curtailing the use of groundwater for irrigation will be the inversely effects on the growth in new jobs in the AZB communities which may pull workers and their families out of their communities, either those permanent or temporary residents. The results of the analysis showed that the employment rate which is currently at 14 percent, would be increased by another 10 percent. When this occurs, the outgoing population affects the social environment in various ways including lower demand for housing and social services (e.g., health care, education, recreational facilities).

During the last three decades, the development of irrigated agriculture in the AZB has favorably contributed to the economy and welfare of its local community and the country at large. However, the unplanned expansion in irrigated cultivated areas and the over abstraction by both private and public sectors for agricultural, municipal and industrial purposes, is threatening what was achieved in terms of economic and social benefits during the last three decades.

Adoption of improved irrigation systems, intensive production systems and introducing high value crops such as cut flowers, strawberries and late table grapes would help in limiting the over abstraction of underground water and would also reduce the unemployment rates in the AZB community.

The share of the livestock subsector in the agriculture economy of Mafraq and Zarqa is relatively high compared to other governorates. Jordan faces a series shortage in livestock products such as red meats and dairy products due to the lack of forages and feed stuff. Adopting the option of transferring some of the

treated wastewater from As-Samra plant to Hashimihah and Dulayl areas would increase the production of forage crops and compensate for the lost jobs due to the adoption of the other reduction options.

The majority of workers in the agricultural sector are not covered under the social security umbrella. Workers who are covered by this program pay a monthly premium to the social security department for a period of time. At the retirement age, those workers start receiving a monthly salary that would guarantee them a decent life. This approach could be used as a remedy for those who will lose their jobs due to adopting the different scenarios. The cost of this option, which should be compensated by the society, would not exceed JD 14,680,000¹².

Another option that could be used to solve the problem of those laborers who would lose their jobs is to provide them with what is called "seed money" to initiate a small projects such as buying some sheep and goats. The Badia region was always known as the main area for raising herds of sheep and goats in Jordan. Those laborers who are expected to lose their jobs could be given a compensation that could be used to buy some animals to start their own business. This approach was adopted by some rural development programs that were implemented through the Ministry of Agricultural in certain parts of Jordan. These programs have proven to be a good vehicle for alleviating poverty in the poor rural areas of Jordan.

¹² The monthly premium paid to the Social Security Department (SSD) by both the worker and the employer is 15 percent of the annual salary for a minimum period of 20 years. For a worker with a monthly salary of JD 120, the total amount that should be paid for the SSD would be about JD 4,320. According to scenario 1, the expected number of Jordanian laid workers would reach to about 3,400 workers. This means the total cost of this option would reach to about JD 14,680,000.